REMARKS

No amendments are being made in this Reply. The pending claims remain as claims 1, 3-24, 49, 70, 73, 74, 77, and 80-83. Claims 1 and 77 are the independent claims.

A declaration under 37 C.F.R. § 1.132 by one of the co-inventors in the Brophy patent relied on by the Examiner, Yongquian Liu, is being submitted with the present reply. The purpose of the declaration is to support Applicant's representations regarding the technical scope of the disclosure in the Brophy patent.

Telephone Interview Summary

We thank Examiner Dzung D. Tran and Supervisory Patent Examiner Jason Chan for taking the time to discuss the application by telephone on May 11, 2006 with Applicant Andrew M. Weiner, and Applicant's representatives Marc M. Wefers and Peter R. Poulin. During the interview, independent claims 1 and 77 and the Brophy patent (U.S. 6,275,623) were discussed. No agreement was reached.

As best we understand, Examiner Tran's position regarding the present application and Brophy et al. (U.S. Patent No. 6,275,623, "Brophy") is summarized as follows: (1) distortions such as "wavelength dependent changes in the state of polarization (SOP) of [an] optical signal", as recited in Applicant's claim 1, are inherent in any multi-wavelength optical beam emerging from an optical fiber; (2) Brophy discloses generally correcting for noise in optical signals; (3) Brophy teaches that his spatial light modulator can be used to vary the polarization or phase of wavelength components of an optical beam, as in Applicant's specification; and (4) all that is needed to correct wavelength dependent changes in the state of polarization of an optical signal, and wavelength and polarization dependent delay variations that accompany such changes in the state of polarization, is provided by Brophy's disclosure. As set forth in detail below, we traverse.

Argument

Claims 1, 3-11, 17-19, 49, 73, 74, and 77 stand rejected under 35 U.S.C. § 102(e) in view of Brophy. Applicant traverses.

Claims 1 requires, in part: (a) "receiving ... an optical signal ... distorted by frequency-dependent polarization effects in [an] optical system that cause wavelength dependent changes in the state of polarization (SOP) of the optical signal"; and (b) "independently adjusting the polarization transfer matrix of multiple regions of [] at least one SLM ***to reduce the distortion of the optical signal***" (emphasis added). Claim 77 similarly requires: "a controller coupled to [] at least one SLM, wherein during operation the controller causes the at least one SLM to independently adjust the polarization transfer matrix of the multiple regions ***to reduce the distortion of the optical signal***" (emphasis added).

Thus, both claim 1 and claim 77 require: (a) that a specific type of distortion be present in an optical signal; and (b) that a particular type of correction be applied to the optical signal using a SLM to reduce the specific type of distortion. This is not the same as merely using a SLM to freely control the phase and/or polarization of an optical signal. Claims 1 and 77 require that the control over phase and/or polarization be applied to correct specific, recognized distortions in optical signals, distortions that are neither recognized nor corrected by Brophy's device.

Brophy fails to disclose the subject matter covered by claims 1 and 77 for several reasons: 1) Brophy does not disclose or acknowledge that distortions arising from polarization dependent effects even exist in his system; 2) even if such distortions do exist in his system, Brophy is not aware of them and his system does not therefore perform steps to reduce them; 3) Brophy's system monitor and feedback devices do not measure the type of information that would be required to reduce such distortions; and 4) Brophy's device, by its very design, discards the polarization information that would be needed to configure his modulator to reduce distortions arising from frequency dependent polarization effects. Each of these points will be discussed in turn. *Moreover, in support of these positions, we also enclose a declaration under 37 C.F.R. §1.132 from one of the co-inventors of the Brophy patent, Yongquian Liu.*

Brophy does not disclose polarization mode dispersion in optical fibers, nor does he disclose frequency dependent phase delays arising from propagation of optical signals through fiber systems. Examiner Tran has conceded that Brophy does not disclose an optical signal "distorted by frequency-dependent polarization effects in [an] optical system that cause wavelength dependent changes in the state of polarization (SOP) of the optical signal", but alleges that such distortions are inherent to any optical signal having propagated through a length of optical fiber. Assuming for the sake of argument that this is true (a point which we do not concede), frequency dependent polarization effects depend upon the fiber system through which an optical signal propagates (Brophy's circulator 104), and Brophy takes no steps to measure or characterize frequency dependent polarization effects in his system. As such, without recognition and characterization of frequency dependent polarization effects in his system, Brophy does not disclose the additional limitations required by the claims, as will be discussed below.

Because there is no teaching in Brophy that his optical signals suffer distortions caused by wavelength dependent polarization effects, and because there is in fact no disclosure or suggestion in Brophy that such problems even exist at all, Brophy's device is not configured to "reduce the distortion of the optical signal" where the distortion arises from frequency-dependent polarization effects, as required by the independent claims. Brophy's device does not correct for a problem that he does not even recognize exists.

Moreover, Brophy's disclosure relates to a different type of problem entirely, namely, controlling amplitudes of spectral wavelength channels in optical systems. Brophy states that his invention relates to "controlling spectral power distributions between channels of wavelength division multiplexing systems" (Brophy, col. 1, lines 7-9). Brophy identifies several problems associated with wavelength division multiplexing (WDM) systems, all of which can "lead to dissimilar received signal power among the channels and a worsening signal-to-noise ratio (SNR)" (id., lines 23-24, emphasis added). To correct these problems, Brophy's device "adjusts the spatial light modulator to achieve a predetermined power distribution among the channels in the output beam" (id., col. 2, lines 6-8). Brophy's device is not configured to reduce distortions

in an optical signal that arise from frequency-dependent polarization effects. Instead, Brophy's device is configured to "[adjust] the spatial light modulator to ***minimize differences between the monitored and desired power distributions***" (id., lines 11-13, emphasis added) and "to ***attenuate wavelengths*** between the channels to improve signal-to-noise (SNR) ratios" (id., lines 18-19, emphasis added). As one skilled in the art would recognize, adjusting power distributions in wavelength channels of optical signals is not the same as correcting for distortions in an optical signal that arise from frequency dependent polarization effects. In fact, configuring a spatial light modulator to adjust spectral power distributions in wavelength channels of an optical signal will not correct for frequency dependent polarization effects in the optical signal. Adjusting power distributions in spectral wavelength channels refers to attenuation of the amplitude of the optical signal in the channels, but correcting for frequency dependent polarization effects refers to correcting for errors in phase and/or polarization in the channels of the optical signal. See also Liu Declaration at 4A and 4B.

Brophy states that his SLM "can function in a variety of ways, such as by directly attenuating amplitudes or by varying phases or polarities in combination with a directional multiplexing device that converts the phase or polarity variations into amplitude attenuations" (id., lines 36-39). He further states that when his SLM is configured to modulate polarization directions of optical signal channels, his SLM is used in combination with "a polarization sensitive optic that exhibits different transmission efficiencies as function of polarization direction" (id., lines 48-50). The polarization sensitive optic can be a "reflective diffraction grating … [that] converts the phase modulation imposed by the spatial phase modulator … into individual amplitude modulations of the different wavelength channels" (id., col. 5, lines 60-63).

Brophy discloses other modulators as well. However, each of the modulators he discloses is configured either to directly provide amplitude modulation to optical signal channels, or to provide phase or polarization modulation to optical signal channels in combination with other elements or processes that convert the phase or polarization modulation to amplitude modulation. For example, Brophy states that "a phase modulator can also be used in combination with a polarization dispersive element for attenuating amplitudes of the spatially

dispersed wavelengths" (id., lines 39-42). He further states that "phase modulation can also be converted into an amplitude modulation by the mechanism of interference" (id., col. 7, lines 54-56). In other words, although Brophy's modulator can be configured to adjust the phase and/or polarization of spatially separated optical signal channels as pointed out by Examiner Tran (and acknowledged by Applicant), Brophy always configures his device so that phase or polarization modulation is converted to amplitude modulation. Thus, irrespective of the internal modulation mechanism of Brophy's SLM (or other modulator), the optical signal that emerges from Brophy's device is corrected for variations in spectral power distributions (e.g., amplitude variations) among the channels, not for distortions arising from frequency dependent polarization effects. See also Liu Declaration at 4B and 4E.

Brophy summarizes the action of his modulator on optical signal channels thus:

> The primary purpose of the modulator **50** is to ***relatively adjust amplitudes*** of the different wavelength channels. Wavelength regions between the channels can also be attenuated to better distinguish the signals from background noise (i.e., improve the signal-to-noise ratio). The amplitude modulation can take place (a) directly using a spatial amplitude modulator such as an acousto-optical modulator or (b) indirectly using a spatial phase or polarity modulator such as a pixellated nematic or ferroelectric liquid-crystal modulator in combination with a phase- or polarity-sensitive element. (Id., col. 5, lines 24-34, emphasis added).

Based on Brophy's own disclosure, optical signals emerge from his device with amplitude modulations introduced by his modulator even when his modulator is internally configured to modify the phase or polarization of the optical signal channels, in accordance with the primary purpose he discloses. Brophy's device is therefore not used to "reduce the distortion of the optical signal" that arises from frequency dependent polarization effects, as required by the claims.

Furthermore, Brophy does not monitor or measure the type of information that would be required to correct for distortions arising from frequency dependent polarization effects. Brophy's detector is a "spectral monitor [that] distinguishes optical power among the channels" (id., col. 2, lines 1-2). Brophy's SLM is connected to "a controller that receives the optical power information from the spectral monitor [and] adjusts the spatial light modulator" (id., lines 5-7). Brophy's SLM, spectral monitor, and controller "are all preferably arranged in a feedback loop to iteratively ***reduce the differences between the monitored and desired power distributions*** among the channels" (id., lines 14-17). Brophy's spectral monitor measures spectral power (amplitude) information. In contrast, the information that would be required to use Brophy's device to correct for distortions arising from frequency dependent polarization effects – namely, phase and/or polarization information among the channels – is not measured by Brophy's spectral monitor. Brophy's spectral monitor is "a diode array" (id., col. 3, line 43) for example. As one skilled in the art would appreciate, diode arrays and other such optical intensity detectors, in the configuration Brophy discloses, would not measure optical phase or polarization. Instead, it is "amplitude variations among the channel portions [that] are detected by the spectral monitor ... and this information concerning the spectral power distribution is communicated to a controller" (id., col. 6, lines 50-53). Therefore, the type of information that Brophy would need to measure to adjust his SLM to correct for distortions due to frequency dependent polarization effects is not measured in his system. Brophy's device is not, then, configured "to reduce the distortion of the optical signal" as required by the independent claims. See also Liu Declaration at 4B, 4C, and 4E.

Moreover, Brophy actually *discards* the spectral information he would need to measure to correct such errors. Brophy's optical beam passes through a polarization manager (30) that "linearly polarizes the wavelength channels in a direction ... that maximizes transmission efficiencies through the filter 10 prior to encountering any polarization-sensitive components of the filter" (id., col. 4, lines 55-59). In other words, before the beam encounters any elements that convert polarization modulation into amplitude modulation (such as Brophy's reflective diffraction grating 40), all of the spectral channels are polarized in a common direction. Thus,

the very information (e.g., the non-uniform polarizations of the spectral channels) that Brophy would need to correct distortions in his optical signal is discarded at the outset, before the optical beam even enters Brophy's spectral filter. See also Liu Declaration at 4D and 4F.

Furthermore, distortions of optical signals can include not only wavelength dependent changes in the state of polarization of an optical signal, but also wavelength and polarization dependent delay variations in the optical signal. Polarization variations and delay variations occur together among the optical signal's spectral channels and are intimately coupled. However, because Brophy discards the information (e.g., the non-uniform polarizations of the spectral channels) he would need to correct distortions in his optical signal that arise from frequency dependent polarization effects, he also discards the information he would need in order to determine and correct for delay variations in his optical signal.

Turning now to Examiner Tran's comments in the Office Action, frequency dependent polarization effects are allegedly disclosed by Brophy in Figures 1 and 2, and at the following points in Brophy's specification: col. 3, lines 8-13; col. 4, lines 55 to col. 5, line 3; and col. 5, lines 34-52 (Action at page 3). Figure 1 shows an overview of Brophy's device that includes optical circulator 20. Applicant assumes that Examiner Tran has cited this figure based on his allegation that frequency dependent polarization effects are inherent in any optical fiber system. Without conceding the veracity of this allegation, Applicant points out that, as discussed above, there is no explicit disclosure or acknowledgement in Brophy that frequency dependent polarization effects even exist or arise from propagation of optical signals through fiber systems. Therefore, such effects may or may not be inherent, but Brophy does not recognize their presence.

With regard to Figure 2, the figure shows a dispersive element (32) that spatially separates orthogonal polarization components of an optical beam. There is no disclosure in this figure of distortions due to frequency dependent polarization effects. Indeed, even if an optical signal has no such distortions, the dispersive element can still operate on the channels as shown in Figure 2. The figure merely illustrates a well known optical effect of birefringent materials.

The first of the cited portions of text refers to Brophy's SLM, which "can be arranged as a phase or polarization modulator that converts the linear polarization of the channels into elliptical polarizations [where the] division of light between the orthogonal polarization axes of the channels affects the efficiency by which the wavelengths are further diffracted into realignment" (Brophy, col. 3, lines 8-13). Applicant has acknowledged that Brophy's SLM can be used to internally modulate phase or polarization of optical channels. However, as discussed above, Brophy's SLM is not used in isolation. Instead, Brophy's SLM is coupled to another optical device that converts the phase or polarization modulation to amplitude modulation so that the wavelength channels in the optical signal emerging from Brophy's device are modulated in amplitude, not in phase or polarization. Brophy's spectral monitor is configured to measure spectral amplitude information, which is then communicated to his controller and used to adjust his SLM. Based on the information received by his controller, Brophy can only correct for amplitude variations among the spectral channels. Furthermore, the information that Brophy would need to measure to correct his optical signals for distortions introduced by frequency dependent polarization effects is not measured by his spectral detector and not communicated to his SLM. Thus, Brophy's SLM is not configured "to reduce distortion of the optical signal", as required by the independent claims. See also Liu Declaration at 4A, 4B, and 4C.

The second of the cited portions of text refers to a polarization manager (30) that "linearly polarizes the wavelength channels" (id., col. 4, lines 55-56). The action of the polarization manager does not "reduce the distortion of the optical signal" as recited in the claims. Instead, as discussed above, the polarization manager *discards* polarization information by separating each wavelength channel into orthogonal polarization components (see id., col. 4, lines 59-63). This process adds further modulation to the optical signal channels, rather than reducing the distortion of the optical signal. Therefore, the polarization manager, alone or in combination with Brophy's SLM, does not perform the steps required by the claims. See Liu Declaration at 4D and 4F.

The third of the cited portions of text refers to Brophy's SLM, and discloses in more detail how the SLM operates. As outlined above, that the SLM can internally modulate phase or

polarization is acknowledged. However, Brophy's SLM, where configured to modulate phase or polarization, is always coupled to a device that converts the phase or polarization modulation to amplitude modulation. Therefore, Brophy's SLM is not configured "to reduce distortion of the optical signal" where the distortions result from frequency dependent polarization effects, as required by the claims. See Liu Declaration at 4E.

Examiner Tran has also cited several portions of Brophy to support his allegation that "during operation the controller causes the SLM to independently adjust the polarization transfer matrix of the multiple regions to reduce the distortion (i.e., improve signal to noise ratio) of optical signal" (Action at page 3). The first of these cited portions is at col. 2, lines 17-19. This portion refers to improving signal to noise ratios in optical signals. However, improving signal to noise ratios is not the same as "reducing the distortion of the optical signal" where the distortion arises from frequency dependent polarization effects. Indeed, as the cited portion states, "the spatial light modulator can also be controlled ***to attenuate wavelengths between the channels*** to improve signal-to-noise (SNR) ratios" (Brophy, col. 2, lines 17-19, emphasis added). Distortions due to frequency dependent polarization effects are not correctable via the amplitude attenuation that Brophy discloses. Because Brophy uses an intensity based spectral monitor such as a diode array, extensive distortions due to frequency dependent polarization effects may be present in the optical signal which are not corrected or even recognized by his device, since frequency dependent polarization information is not measured by his spectral monitor. Improving signal to noise ratios, as disclosed by Brophy, is therefore significantly different from reducing the distortion of the optical signal as recited in the claims. See also Liu Declaration at 4A, 4B, and 4C.

The first of the cited portions is at col. 2, lines 32-42. The first part of this portion states that "preferably, the parallel polarizations follow similar optical paths through the wavelength dispersing system to further reduce polarization-dependent losses" (id., lines 32-34). In other words, varied optical paths through polarization sensitive components (such as Brophy's diffraction grating) can result in varied transmission efficiencies. However, reducing polarization dependent propagation losses in Brophy's device is not the same as reducing the

distortion of an optical signal. Reducing "distortion of the optical signal" refers to distortions present in the optical signal as it emerges from another optical system such as a fiber system, not to propagation losses within the modulator.

The second part of the cited portion (see id., lines 35-42) refers to Brophy's SLM, and confirms that his SLM can function "by directly attenuating amplitudes or by varying phases or polarities in combination with a directional multiplexing device that converts the phase or polarity variations into amplitude attenuations" (id., lines 36-39). Alternatively, "a phase modulator can also be used in combination with a polarization dispersive element for attenuating amplitudes of the spatially dispersed wavelengths" (id., lines 39-42). As discussed above, Brophy's own disclosure affirms that his SLM, whether used alone or in combination with additional elements, produces an optical signal with amplitude modulated wavelength channels. As discussed above, amplitude modulation does not "reduce distortion of the optical signal" as required by the claims.

The third of the cited portions is at col. 3, lines 20-25. This portion refers to a control loop that includes "a converter that adjusts the individual amplitudes of the channels based on differences between the actual amplitudes and desired amplitudes of the channels" (id., col. 3, lines 22-25). Correcting individual amplitudes of channels is not the same as reducing "the distortion of the optical signal", as required by the claims. To the contrary, as discussed above, an optical signal can have significant distortions due to frequency dependent polarization effects, but if the amplitudes of the spectral channels are the same, then Brophy's system, as disclosed, would not correct such distortions.

The fourth of the cited portions is at col. 5, lines 24-33. This portion has already been reproduced in full above. As discussed previously, Brophy's disclosure affirms that his modulator adjusts either: (a) amplitude; or (b) phase or polarization, in combination with elements that convert the phase or polarization modulation into amplitude modulation, of an optical signal. Adjusting amplitudes is not the same as reducing "the distortion of the optical signal" due to frequency dependent polarization effects, and in fact the amplitude modulation

disclosed by Brophy does not reduce distortions in an optical signal that are due to frequency dependent polarization effects. See also Liu Declaration at paragraph 4E.

Based on the portions of Brophy cited by Examiner Tran, Applicant reiterates that Brophy does not disclose an optical signal "distorted by frequency-dependent polarization effects that cause wavelength dependent changes in the state of polarization (SOP) of the optical signal" as required by the claims. Whether or not such distortions are inherent in Brophy as alleged by Examiner Tran (a point we do not concede), Brophy's failure to acknowledge the existence of such effects and his failure to measure information using his spectral monitor which would be required to correct for such effects ensures that his system is not configured "to reduce the distortion of the optical signal" as required by the claims. Accordingly, Applicant requests withdrawal of the rejection of claims 1 and 77 under U.S.C. § 102(e). Each of the dependent claims rejected under 35 U.S.C. § 102(e) depends from one of the independent claims, and all of the dependent claims are therefore allowable for at least the same reasons discussed above. Therefore, Applicant also requests the withdrawal of the rejection of the dependent claims under 35 U.S.C. § 102(e).

Claims 12-16, 20-24, and 70 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Brophy in view of Wefers et al. (U.S. 5,719,650, "Wefers"). Without addressing the appropriateness of this combination of references (which we do not concede), Applicant submits that Wefers does not cure Brophy's deficiencies in regard to independent claims 1 and 77. Accordingly, claims 12-16, 20-24, and 70 are allowable for at least the same reasons outlined above for claims 1 and 77, and Applicant requests the withdrawal of the rejection of these claims under 35 U.S.C. § 103(a).

In summary, Brophy's failure to disclose or even acknowledge the existence of distortions in his optical signals that are due to frequency dependent polarization effects and his failure to disclose or provide a spectral monitor that measures information that could be used to correct for such distortions ensures that his system is not configured "to reduce the distortion of the optical signal" as required by the claims, regardless of whether such distortions are inherent or not. In fact, Brophy's disclosure relates to a different problem entirely – that of controlling

spectral power distributions in wavelength channels – and as such, his device is configured to control amplitude modulation in wavelength channels, not to correct for distortions arising from frequency dependent polarization effects.

We therefore ask the Examiner to withdraw the prior art rejections.

Conclusion

In view of the above, we ask that the application be allowed.

Canceled claims, if any, have been canceled without prejudice or disclaimer. Any circumstance in which Applicants have: (a) addressed certain comments of the Examiner does not mean that Applicants concede other comments of the Examiner; (b) made arguments for the patentability of some claims does not mean that there are not other good reasons for patentability of those claims and other claims; or (c) amended or canceled a claim does not mean that Applicants concede any of the Examiner's positions with respect to that claim or other claims.

Enclosed is a $225 check for the Petition for Extension of Time fee. Please apply any other charges or credits to deposit account 06-1050, referencing 12818-003001.

Respectfully submitted,

Date: 7/7/06

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